Interference and the Wave Nature of Light

Interference:

Constructive Interference: two identical waves arrive at a point in phase and reinforce each other

Destructive Interference: two identical waves arrive at a point out of phase and cancel each other

⇒ two waves that are initially in phase can arrive at a point out of phase if they travel different distances

constructive interference: $\Delta L = L_2 - L_1 = m\lambda \quad m = 0,1,2,...$

destructive interference: $\Delta L = L_2 - L_1 = (m + 1/2)\,\lambda \quad m = 0,1,2,...$

Young's Double-Slit Experiment:

bright fringes: $\sin\theta = \dfrac{m\lambda}{d} \quad m = 0,1,2,...$ *dark fringes:* $\sin\theta = \dfrac{(m+1/2)\,\lambda}{d} \quad m = 0,1,2,...$

⇒ use **y = L tanθ** to find the distance between the fringes

Thin Film Interference:

⇒ the wavelength that is important is the wavelength within the film: $\lambda_{film} = \dfrac{\lambda_{vacuum}}{n_{film}}$

⇒ there is a ½ λ phase change when light reflects from a region with a higher index of refraction

⇒ if only one of the waves undergoes a ½ λ phase change:

constructive interference: $2t = (m + 1/2)\lambda_{film} \quad m = 0,1,2,...$

destructive interference: $2t = m\lambda_{film} \quad m = 0,1,2,...$

⇒ if neither of the waves or if both waves undergo a ½ λ phase change:

constructive interference: $2t = m\lambda_{film} \quad m = 0,1,2,...$

destructive interference: $2t = (m + 1/2)\lambda_{film} \quad m = 0,1,2,...$

Diffraction:

dark fringes for single-slit diffraction: $\sin\theta = m\lambda/W \quad m = 1,2,3...$